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A Case Study to Explore Influence of Traceability Factors on Australian Food Supply Chain Performance

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Abstract

Traceability in food supply chain has been an area of interest due to the challenges associated the nature of the food supply chain with short code date, high safety and risk associated with quality. With the introduction of EU Regulation 178/2002 to have mandatory traceability for food supply without defined structure of product or process to be traced makes the level of traceability a vulnerable aspect across the supply chain. The level of traceability is strongly associated with the resources required to trace & track and the supplier buyer relationship, which would help to implement an effective traceability systemThe objective of the study is to understand the interrelationship between the level of traceability (breadth, depth and quality of information) and the resources required (technology, financial and human) in achieving the given level of traceability and contribution of supplier-buyer relationship on the supply chain traceability performance using a case study based approach.
The study shows as the dairy products are split into individual unit for the retail stores and not associating the batch number to the product movement from the distribution center to the retailers would create the critical traceability point where the product's flow of information could be lost. The other important finding shows that the effective uniform tracking and tracing system would help in efficiency gain by reducing the product receiving time approximately from 4hours to 20 minutes, which can reduce in humanly efforts at this stage and may help in achieving huge cost savings.

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Keywords: Traceability; Level of Traceability; Dairy products; Food supply chain

1. Introduction

Food supply chain is complex supply chain as compared to other supply chain mainly due to different attributes associated with the nature of product which has direct impact on consumer health making food safety as one of the important requirement (Aung and Chang 2014). Food safety in broader spectrum can be classified as the assurance with intended quality which would not cause harm to the consumers and adhere to the recommended use specified

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by the manufacturer (Manfreda and De Cesare, 2014). The outbreak of Bovine Spongiform Encephalitis (BSE) disease, the melamine incident in China where the infant milk was adulterated with melamine, which resulted in serious consequences, moved food industry to consider the safety and quality of the food products as the primary requirement before the product reaches the end customer. Hence the traceability is used as one of the tool to monitor the product across the supply chain to identify the product source and origin to track and trace efficiently from 'Farm to Fork'.

There is a decline in the customer's confidence in the food industry due to many factors like the food safety incidents, socioeconomic reasons like the sustainability of the food supply chain where the globalization has made it more complex to track and trace the product to its origin (Kok et al. 2012). The implementation of traceability would be really challenging task due to the lack of common theoritical framework as for any company to implement a system they have to consider many aspects from the products, cost, level of traceability required for each product, method of tracking the product (Electronic Vs Manual) which makes the traceability a challenging aspect for the companies to consider (Karlsen et al. 2013).

Food traceability has different definitions as per the standards as listed in the Table 1 which give the general requirement of traceability.

Table 1: Definitions of Food Traceability from Standards

Definitions	Standard
The ability to trace the history, application or location of an entity by means of recorded identifications.	ISO 8402
The ability to trace the history, application or location of that which is under consideration	ISO 9000 & ISO 22005
The ability to follow the movement of a food through specified stage(s) of production, processing and distribution	FAO/WHO 1997
The ability to trace and follow a food, feed, food producing animal or substance intended to be, or expected to be incorporated into food or feed, through all stages of production, processing and distribution	EU 2002

Olsen and Borit (2013) empirical literature review on defining Traceability and emphasized should be given access to all the property of the food product, in all its different form across the supply chain which includes backward (Trace), forward (Track) and it should include the systemic record keeping which would encourage in the unit identification or tracking method involved to trace all the products across the supply chain which was supported by Bosona and Gebresenbet (2013) by defining "Food traceability is part of logistics management that capture, store, and transmit adequate information about a food, feed, food-producing is correct animal or substance at all stages in the food supply chain so that the product can be checked for safety and quality control, traced upward, and tracked downward at any time required" which would address the quality and logistics prospective of traceability application in the supply chain network.

2. Literature Review

The globalization of the food industry poses a high requirement to have good traceability system with the associated challenges due the distance the product has to travel before it reaches the customers. Traceability in food supply chain acting as a tool to monitor the quality, legal requirements, with the potential to increase the operation efficiency and customer confidence in the food sector is the important aspect (Aung and Chang 2014). The implementation of common traceability system across the supply chain could pose lot of practical problems as each

product and each partner under the supply chain would perceive the traceability from different prospective (Karlsen et al. 2013). Traceability holds high importance in the perishable food sectors which has short shelf life and possess high health risk of contamination.

As traceability is complex subject and has different drivers like legislation requirement(Regattieri, Gamberi, and Manzini 2007), production optimization, food safety & quality (Aung and Chang 2014), sustainability (Brofman Epelbaum and Garcia Martinez 2014), welfare, certification (Azuara, Tornos, and Salazar 2012), competitive advantage, chain communication and bioterrorist threats and the level of traceability required within the company and across the supply chain (Hoorfar 2011) make traceability complex to originate towards common theatrical framework for implementation.

The traceability in the food products are applied in the individual product, batch or logistics units called as the traceable unit based by assigning the unique identification number or method from the raw material identification to the finished products. This would help to track and trace the product in a limited quantity rather than the bulk manufacturing (Wang, Li, and O'Brien 2009). Hence it is very important to analyze the traceable unit and assigning the correct level of traceability which would help the company to associate the application of these systems with the performance enhancement.

The traceable unit identification is unique to each product and process which leads to consider the information or data to be tracked for each product to give the unique identification through supply chain, product dimension and product life cycle to address the complete traceability system (Regattieri, Gamberi, and Manzini 2007). This aspect leads to considering the appropriate technology to track and trace the product across the supply chain.

The technological used in traceability ranges from Alphanumerical code, Barcode, RFID (Barge et al. 2014) application in the dairy industry to track and trace the cheese by item level, Quick response two dimension barcode (QR code) (Tarjan et al. 2014) to internet based traceability (Frederiksen et al. 2002) where fish traceability is monitored using the internet based system to track and trace the product. These technologies have the basic application of tracking and tracing the product more efficiently and effectively. The cost benefit for each supply chain actors has to be considered for the implementation of more robust system.

Gaps in literature:

The literature review shows the area that need to be studied in future include the depth of traceability with the inter organization collaboration would help to attain the supply chain tracking and tracing (Dabbene, Gay, and Tortia 2014). The effective communication and information sharing across the supply chain which is the key intent of applying traceability would attain its importance if the resources used to track and record the information is shared across the supply chain are uniform (Kher et al. 2010). These areas have to be considered for the better understanding of traceability implementation across the supply chain with the common goal of tracking and tracking the product from ‘farm to fork’

The case study research method is used to conduct the research due to the criticality associated with the question where the research to find out ‘how’ (Yin 1994) the distribution and retailers perceive food traceability in an unintegrated supply chain where each player is working towards their own goal. The case study would help to explore and move toward the explanatory research where the operational links need to be traced over time (Easton 2010). As the current study in the Australian food sector to understand the relationship the distributor and retail would have in an unintegrated supply chain and how these would impact the implementation and sustainability of supply chain traceability. Hence, the case study method is selected which gives the opportunity to explore the subject in depth as the relationship are important aspect of the study.

3. Research Model

The current study is to understand the influence of the effective traceability, which would include the Depth, Breadth, Precision and Access and the Resources involved in the traceability influence on the supply chain performance and if these factors are having an efficient supplier Buyer coordination what would be influence on the supply chain performance.

3.1 Level of traceability

Traceability Level includes breadth which addresses the level of attribute tracked and traced and depth defines how deep the traceable unit is tracked in the supply chain network and precision (degree of assurance). The access, precision and timeliness of data represent the speed of tracking and tracing product in the supply chain, which needs to be addressed as different actors in the supply chain have different orientation (Dabbene, Gay, and Tortia 2014).

3.2 Resources to implement level of traceability

Brofman Epelbaum and Garcia Martinez (2014) studied the application of traceability based on the Resource Based View (RBV) shows the physical and human resource positively related to sustainable performance of supply chain. The effective communication across the supply chain is the key area for the traceability implication which needs to address the common system implementation to track and trace the product across the supply chain (Kher et al. 2010). Hence the requirement to have Technical, Financial and the Human resource (Bosona and Gebresenbet 2013) to implement higher level of traceability is an important aspect.

The technical resources would be having the common system of tracking and tracing the products across the supply chain which would reduce the redundancy and help to improve the supply chain traceability where the data would be transmitted from one partner to the other partner in more systematic and standardized format. The cost of implementation and sustaining supply chain traceability is one of the important aspects to consider in relation to the complexity of the supply chain under financial resources. The ownership of traceability implementation and data management has to be considered in relation to implement effective chain traceability. The requirement to have the willingness to implement an advance system and having the skilled resources to sustain the implementation and management would be an important aspect under human resources. The different partners in the supply chain perceiving traceability differently can bring in the awareness limitation which could be the source of human resource constraint to have an effective traceability system.

3.3 Supplier- Buyer Relationship

The inter organization relationship defined as the cooperative relationship between the buyer and the supplier with operational performance benefits (Vanpoucke, Vereecke, and Boyer 2014). The level of traceability would not be determined by the single company as the information traced vary across the supply chain and relies on the agreement between the buyer and supplier (Dabbene, Gay, and Tortia 2014). Hence the buyer supplier commitment and the integration is one of the requirements for traceability implementation. Integration which is the process of sharing information and resources among the buyer supplier requires cooperation and collaboration (Droge, Vickery, and Jacobs 2012). The coordination would address the supply chain uncertainty, effective business planning and would lead to close working relationship. The effective communication between the supplier buyers would enhance the trust level which is one of the important elements in implementing the new advanced technology to share information and which would result in mutual benefit(Ha, Park, and Cho 2011). In the proposed model, the following variables are considered under supplier buyer relationship.

Willingness to share information:

Common goal of implementing traceability across the supply chain would require higher commitment and willingness to share information among all the partners (Bosona and Gebresenbet 2013).

Cost Sharing:

The implementation of traceability, the ownership and sustainability cost has to be analyzed and shared across the supply chain partners who would help to standardize the cost-benefit associated with the implementation of advance system to track and trace the products.

Capacity of partners

Bevilacqua, Ciarapica, and Giacchetta (2009) states identifying the leading company in the supply chain network who would be the strong player and can take the responsibility who can be referred as the single clear point of contact for the traceability coordination. The sharing of burden and benefits of traceability would be an important factor but always requires stronger party in supply chain to drive the initiative and push the other partners in the network to work towards the common framework.

3.4 Supply chain performance

The benefits of traceability application in the supply chain is quantified by many research addressing the operation efficiency by applying the traceability to batch processing which reduce the recall cost as the raw materials are traced with respect to batch production (Dupuy, Botta-Genoulaz, and Guinet 2005) (Tamayo, Monteiro, and Sauer 2009). Traceability study in supply chain shows positive relation to the inventory management (Alfaro and Rábade 2009), operation performance (Li et al. 2014), reduction in recall cost (Dupuy, Botta-Genoulaz, and Guinet 2005) which has direct influence on the supply chain performance by efficient and effective information sharing (Zelbst et al. 2010). Sarac, Absi, and Dauzère-Pérès (2010) literature review further emphasizes RFID as a traceable unit influence on supply chain performance shows improved visibility across supply chain, operation flexibility which influence inventory management and accurate real time information sharing. These strong relations of traceability on supply chain performance have an influence on the supplier buyer relationship as level of traceability is hard to determine by the single company as the information traced vary across the supply chain and relies on the agreement between the buyer and supplier (Dabbene, Gay, and Tortia 2014). Hence the food supply chain performance has to be evaluated against the overall goal to achieve the required traceability which can act as the strategic tool. Bosona and Gebresenbet (2013) who has categorized the performance into compliance, process and market oriented performance level is studied along with these other two factors are considered to evaluate the supply chain performance which include significance of partnership and the supply chain sustainability from economic prospective.

The proposed conceptual model can be seen in Figure 1.

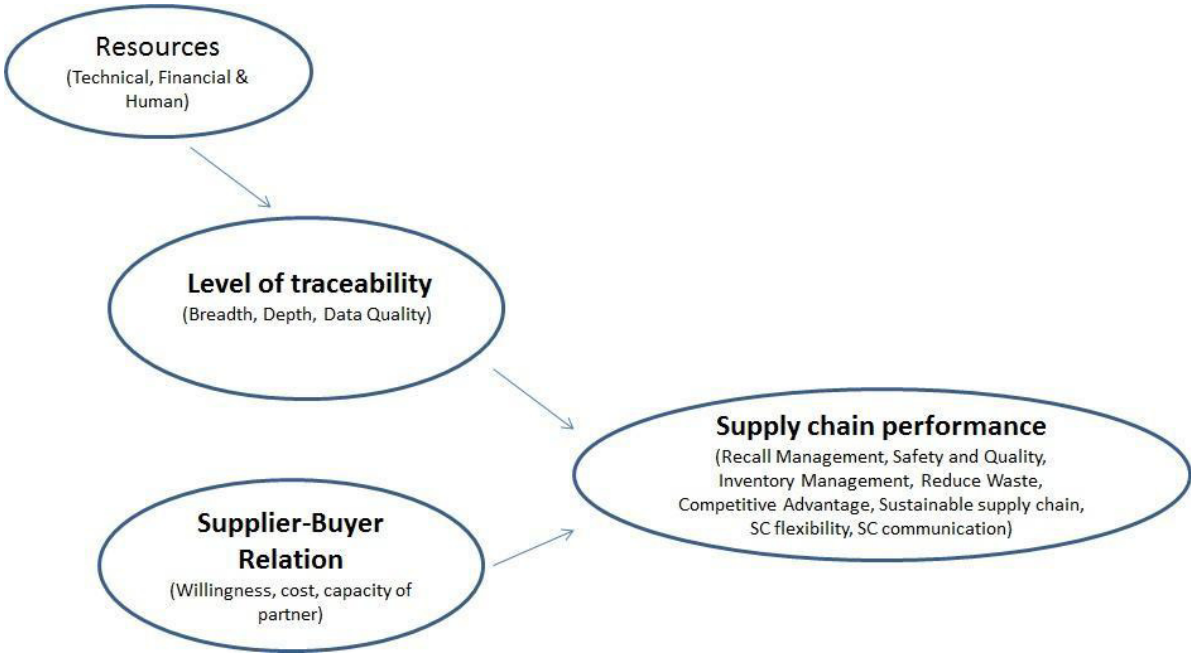

Figure 1: Conceptual model to capture food traceability at distributor

4. Food Traceability at Distributor

The Distribution center under study is one of the Australia's leading wholesale distributions and Market Company specialized in grocery, Fresh food, Liquor, hardware & automotive parts and accessories. It is one of leading distribution center to supply most of Independent Retail sectors in Australia. They hold 30-31% of market shares and have more than 700 employees working for the organization.

The supply chain works on the unintegrated supply chain network where they distribute the goods to the independent retailers. They hold 3 weeks inventory for most of the products. The cold product distribution involves around 50 employees having key suppliers like Nestle, Naithan Jones, Lions for chiller products. The cold chain is compliant to Hazard analysis and critical control points (HACCAP) requirements and have regular internal and external audit to meet the regulatory requirement of the cold chain. The company has a good software system which is used efficiently to manage the products received and to store and maintain the information related to each product for the internal purpose.

In the current case study, the level of traceability is studied in the below aspects to identify what is the level of information recorded (Breadth), what is the level of information shared (Depth), the data quality (Access, precision and timeliness) for the company at the time of requirement.

4.1 Level of traceability at distributor

This study is conducted in relation to the Dairy products with high perishability index and increase risk on safety and quality issue on human health. These products are studied in details to understand the influence of traceability of these products on supply chain performance.

Breadth

While receiving, the unit traced is based on the pallets. In the current case study the dairy products are received and product physical characteristics are recorded in the system which would include the carton height, breadth, and weight. The below information of the products are recorded once the products are received.

Temperature
Used- by date
Physical characteristics

Once the products arrive at the receivable the products are verified (initial verification) for the acceptable level of 5° C temperature while loaded in the truck itself. This temperature is recorded in the register. The temperature check is performed at 3 stages initially in the first pallet before unloading, later in the middle of the truck and last at the end of the truck to see if all the pallets are kept at the required temperature.

The used by date of the products are verified which acts as one of the primary and important information for the company to record and cross validate as these products, which would produce with very short used by date if arrived lately would impose the difficulty of product sales. The pallet are randomly checked for the leaking, carton shape distortions which can highlight the product would have been damages and these aspects are verified and rejected if does it is damaged or not kept at right temperature.

If the product does not comply with the requirement they are rejected, where the supplier would be informed about the rejection reason and the goods would be sent in the same truck. If the truck is left then they would work around with the supplier to pick the rejected items on their other runs.

The product type and the demand are the two criteria to set up the minimum acceptance date and each product would be set up in the system for the lowest date of acceptance. These would be verified while receiving the product. For example if the product is fast moving like the milk then they would accept within 20 days and if the line is slow moving and requires more used by date ie more than 20 days to sell the product to retailer and then to the customer then they would require higher used by date to store and redistribute the products.

The products are received in the temperature controlled WH, stored at the required temperature based on the chiller or freezer product category and monitor the temperature manually every day to see if the required temperature is displayed.

The products are not sold to retailer if they have only 10 days or less shelf life and it would be either donated or discarded. For dispatching, the used by date is considered as one of the primary and important aspect from the distribution point of view and First in First out (FIFO) methodology is adopted to prevent waste.

Depth

The current supply chain is an unintegrated where the supply chain integration is comparatively low. The depth of information across the supply chain is not effective.

The supplier selection and product orders are done by centralized distribution system. The physical dimensions of the products are shared electronically but not the used by details. The receiving team has to enter it manually by verifying each pallet. The temperature storage details are not shared.

The Serial shipping Container code (SSCC) which are eighteen digit non-significant number uniquely attached to the logistics units (Pallet of carton) to ensure worldwide uniqueness of general code structure, which allows the tracking and tracing of unit and help to record the flow of information more efficiently. These labels are used by few suppliers, which can be scanned across the supply chain which helps to integrate the information of the product. For other suppliers, products are received and generic bar code is generated by the warehouse to store the product information.

The temperature details of the products leaving from the supplier, while the product in transit during transportation is not verified by the WH. The product travelling longer distance has the changes of storing at different temperature as the truck has to constantly monitor the temperature across the travel time.

Hence once the product moves out of the WH to retailers the product flow would be lost. The order picked for the retailers are not assigned to the batch number of the product and these information is not stored. The WH does not share any temperature information or the used by date information with the retailer for every order. The retailer has to intern check each and every cartons for their used by date.

The supplier will contact the distribution center when there is product recall and as the distribution center will not track the flow the product based on the batch number they would work backward to see the product sales in the given time and contact the stores where the product is dispatched to verify if the give batch product would be on their selves.

Quality of information (Precision, Access, Timeliness)

The internal precision of information is really high. As the advance system is used to manage the inventory and product flow information, the assurance of information required internally is really high. The product flow is recorded in the system based on the sales details but in relation to the traceability they would not have high assured information at the time of recall as the batch numbers are not related to the product flow. The current level of precision is really low from supply chain prospective for the dairy products in the current case study.

As the level of traceability is not high in an unintegrated supply chain as the access to information is very limited. The supplier, distributor and retailers have their own system of recording information; hence the information does not flow across the supply chain very effectively. The access to information in the currently case study is high internally but when the product has to tracked for the history they have to run the report based on the sales and relate the customer to the given date to identify the product flow.

The timeliness of information is one of the important aspects as the information of temperature variation given at the right time would help to correct the problem immediately before the product contamination.

In the current case study the timeliness of data sharing at the time of recall or product crisis can be little longer. As the batch number of the product is not tracked after the supplier has sent the product to the distribution center, they would contact all the store who has received the given product in the given time of recall to verify if the current batch is available in the store.

4.2 Resources for implementing level of traceability at distributor

The required level of traceability varies based on the product type and the risk associated with the product. The level of traceability considerably varies across the supply chain depending on the each partner requirement to track and trace the product. In the current case study as the distribution center would hold the product and move to the retailer they would not be interested in too much of product information as it can add burden for information management.

The resources play a vital role for the implementation or sustainability of traceability. The use of common system across the supply chain can help to achieve higher level of traceability but it also important to consider various contributing factors to this implementation to take place. In the current case study the warehouse has the advanced

system to track the product internally but lack the supply chain traceability resources. The requirement of implementation of traceability has to be associated with the cost benefit ratio and identifying the key participant to push these requirements across the supply chain. As an unintegrated distribution partner the benefit of traceability of supply chain is not quantified by the partners as they are more interested toward the inventory management and moving the products more efficiently.

Technical Resources

The current system used in the distribution center is both manual and automated to receive the products. The bar codes are scanned for the automated process and manual tracking is used for the products supplied by the supplier who does not use the SSCC labels. The current system helps to generate internal report for product monitoring and managing the inventory. The perishable products are monitored continuously to see the used by date and plan more efficiently to reduce waste. But the supply chain traceability with the current system is not efficient. The product information are not moved from the distribution center to the Retailer in terms of the temperature recorded, used by date, batch number or any other information.

Financial Resources

The current system to track the product is owned by the distribution center. The systems are not integrated with the retailer or the supplier to have the financial sharing of cost. Each partner in the supply chain have their own system of monitoring the product. No common information system is present across the supply chain. The lack of common system can be due the cost, lack of knowledge of benefits.

Human Resources

They used the manual system to track and trace the product and as there is no information sharing from the supplier.

'The example cited in one the interview shows the supplier with efficient system can reduce the human work of receiving the product to 20 min which would otherwise take more than 4 hours for the supplier with no tracking system'.

4.3 Supplier-Buyer Relationship perceived by distributor

The coordination between their supplier and buyer is limited as the each entity in the current case study work more in isolation. The supplier and buyer are integrated to promote the products and sales to plan the promotion of few products but they lack the efficient information sharing which can help the traceability to be more efficient. The supplier buyers are collaborated more efficiently at the time of product recall where the products are tracked back based on the sales data to verify the products distributed to different retailers. Then the retailers are contacted to verify their inventory for particular batch product, hence this would be the long process and can critically affect if the recall is of high risk and danger.

Willingness of partners

The supplier-buyer relationship would impact the supply chain traceability but requires high trust and commitment. As the supply chain is not integrated, the same supplier would supply the competitive partners as well in the same industry which would impact the willingness to share information. The trust and confidentiality of information like using traceability to monitor the inventory is one of the important factors. The confidential information like the strategic information sharing to the competitor can affect the common system. Each partner's feels the extra information can be burden and requires more efforts. For ex continuous monitoring of temperature across the supply chain would require more efforts.

Cost

Cost is an important aspect as the distribution center would help to implement any new system which would contribute to higher profitability for their investment. The supply chain traceability cost has to be triggered from the bottom of the supply chain and the cost and benefit sharing association would help all the partners to contribute towards the common system of implementation.

Capacity/size of partners

As the distribution center has many suppliers for each product group implementing the common tracking system would impose lot of practical challenges. As there are many small suppliers or retailers who would not be advance to track the products and they would even not use the common bar codes which can be scanned across the supply chain.

4.4 Supply chain Performance

As the current system has more efficient internal tracking and tracing in comparison to the supply chain traceability, but they strongly believe the implementation of common system across the supply chain would help to improve the entire supply chain performance and make the supply chain more competitive.

The supply chain performance monitoring is not present in the current system as the relationship between the different partners in the current study is more individual. The distribution center would perceive the movement of product as more important aspect of performance where the higher information would be considered as the burden.

Level of traceability would impact the supply chain performance as the breadth would cover recording all the relevant information of the product, depth helps to share the information which can reduce the duplication of work by improving the supply chain performance, Quality of information which acts as the basis for performance measurement to track and trace the product by intern reducing the distortion of information.

Sustainability of supply chain

But with the legal requirement, to achieve more sustainable supply chain performance in the competitive market is perceived as the important aspect. The reduction in the recall cost and the risk can help is considered as the very important aspect of supply chain traceability which helps to manage the waste.

Inventory and Waste Management

The perishable supply chain with short used by date needs high inventory management and induces waste at many stages in the supply chain from the supplier, distributor to retailer. By the implementation of traceability across the supply chain which can give more accurate and timely information can help to reduce the waste in turn helping to improve the supply chain performance.

Safety and Quality

The traceability of product from the origin to end customer would help to achieve high safety and quality. The product safety and quality of the products are checked internally by checking the product temperature, maintaining the product temperature in the WH and moving the product out of WH at the right temperature which is one of the important requirements to maintain for dairy product. But monitoring the in transit temperature is not efficient.

Even though these are considered as the advantages of the supply chain performance, the lack of cost of implementation, ownership needs more clear understanding, the product type and risk associated has to be studied in detail to understand the requirement. The case also shows even the presence of automation can reduce the cost but the ownership of maintaining and checking the product from each player in the supply chain also plays an important requirement to maintain the product quality and safety.

5. Discussion

Resources and Level of traceability on supply chain performance

As the current case study the level of information recorded at pallet level. The physical characteristics are checked if the products are not kept at the right temperature and not for the entire product. This leaves a gap of not checking the quality of all the products before receiving. Once the products are received and dispatched from the WH the product batch number details are not linked to the product moving out of the WH. Hence, this can create critical traceability point of losing information of the product batch details once they are redistributed to the retailers. As they don't have any advance system like RFID to track and trace the product at all given point of time this has the potential loss of valuable information. The absence of continues monitoring process can affect the implementation of effective and efficient traceability system.

Absence of SSCC labels can create more manual work, increase the labor involvement and errors in receiving the product. As the product batch number are not associated with the product moving out of the WH, this can result in long and manual process of product recall. This can create high risk if the recall is of serious issues.

The challenges associated with the information sharing where the systems are different across the supply chain, the lack of integration can impose more practical challenges. As the product moved out of the supplier the information of the temperature, in transit product storage information is not shared by all the partners. If the products are stored in-transit location there are chances the product temperature could have varied which compromised product quality but again it will be restored to the require temperature while receiving at the end supply chain partner. Hence the lack of continuous information sharing can create challenges to monitor the product quality.

As each player in the supply chain use different system to track and track the product internally this can impose great technical challenges to integrate the system to share information by using automated process to reduce the manual work and redundancy of work. As the short used by date of few dairy products needs more critical monitoring across the supply chain to manage the product more efficiently it requires higher information sharing to reduce the wastage at all stages.

The financial burden of implementing the uniform system has to analyze more effectively by associating the benefit to each player in the supply chain network to promote the advance system implementation for the traceability of product. The analysis of waste associated with the perishable product by each sector in the supply chain would help to share the cost to implement the common traceability system. The case study shows if the traceability to implement the common system across the supply chain would benefit all the partners and the cost of implementation and sustaining the system has to be shared more efficiently and effectively

The traceability systems implement across the supply chain which can bring the automation of the manual work can reduce the humanly effort required in monitoring the system, even it can reduce the human error of recording same information at many stages in the supply chain.

The table 2 shows the resource allocation to capture the level of traceability internally and across the supply chain (External) in the current case study.

The technical resource is considered medium internally because the complete process of receiving in not automated as there is mixture of automated and manual tracking for the products. The technical resource to share the information across the supply chain is really low due to lack of supply chain collaboration.

The financial resource for the internal traceability is high as the financial requirements are met by the distribution center without any cost sharing which results in the low external financial resources.

Human resource involvement is really high in the internal system as the products are checked manually at many points to monitor the recall, inventory and temperature. The human resource implication in medium externally as

there is no complete information sharing from the supplier with regard to product. The product physical dimensions are shared, but there is no temperature or storage information is shared with by the supplier nor does the distribution center share these information with the retailers.

The Technical, Financial and Human resource is considered high for the depth of internal traceability as all these resources requirement are met by the distribution center. The distribution center stores the incoming information and outgoing information for the internal purpose but does not share across the supply chain.

The technical, financial and human resources are considered as low as only few information is shared like the product dimension. The information sharing at the time of recall, the distribution center still able to track the product by the sales but this would not give the precise information of product location. There is no resources sharing from the supplier or retailer which shows the low depth of traceability.

Table 2: Relationship of Level of traceability and Resources

Dairy products		Breadth	Depth	Date Quality
Technical Resources				
Internal	High			
	Medium			
	Low			
External	High			
	Medium			
	Low			
		Breadth	Depth	Date Quality
Financial Resources				
Internal	High			
	Medium			
	Low			
External	High			
	Medium			
	Low			
		Breadth	Depth	Date Quality
Human Resources				
Internal	High			
	Medium			
	Low			
External	High			
	Medium			
	Low			

Scale: Internal (High: Met internally, Medium: Some degree of sharing, Low: No Sharing), External (High:

complete sharing, Medium: Some degree of sharing, Low: No Sharing)

The technical, financial and human resources are considered medium for internal and external system for dairy product as few supplier use SSCC labels which helps the scanning of the product, but the presence of manual process does not show there is high degree of data management.

As shown in Table 3 the level of traceability influence on supply chain performance.

Table 3: Relationship of level of traceability to supply chain performance

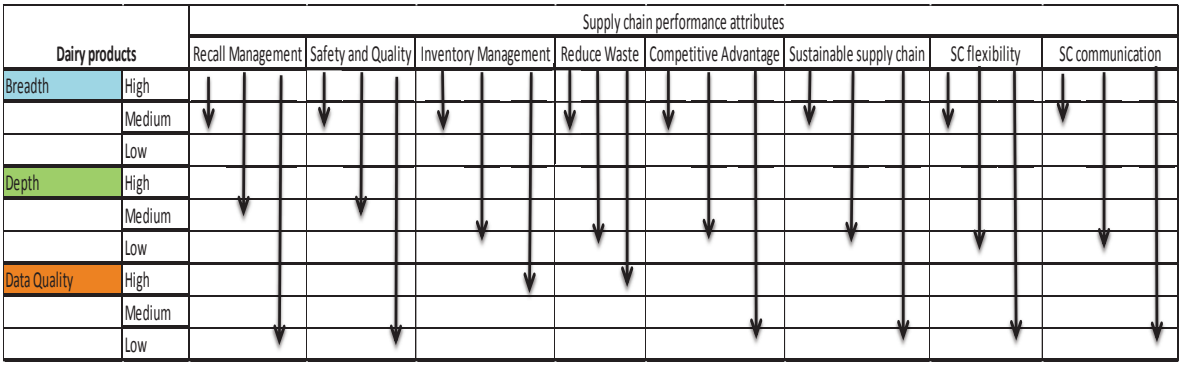

Table 4. Scale for measuring Level of Traceability considering supply chain performance

Breadth		
High	Medium	Low
Temperature, Expiry Date Batch number, Process History, Product physical characteristics, Product/process certification	Temperature, Expiry Date, Product physical characteristics	Temperature and Expiry date
Depth		
High	Medium	Low
Supply chain network	One step forward & one step backward	Only Internal
Data Quality		

High	Medium	Low
Access, Precision and Timeliness	Access and timeliness	Either Access/precision/ timeliness

As shown in Table 3 the level of traceability influence on supply chain performance.

Recall management & Safety and Quality:

The current case study shows medium breadth of information recording, sharing and low level of data quality. As the batch number are not associated with the product the WH can access the information by using the sales data but would not be able to precisely track the information of the customer and as the process is more manual it can time consuming. This can make the recall process more risky. The delay in recall can increase the risk of safety and quality.

Inventory & Waste Management:

The breadth of information recorded is medium but the information shared (depth) is considered low as there is no inventory information is shared with supplier nor the retailer. The data managed for the internal inventory is really high as they track the product on daily basis by using the used by date (Expiry date) even this helps the WH to manage the waste more efficiently. But the absence of depth has the possibility of creating the bull whip effect and considering the nature of short shelf life product this has the potential of increasing the supply chain waste.

Competitive Advantage, Supply chain sustainability, Flexibility and communication:

The breadth of information is would remain the same at the medium level but due the low depth and data quality management across the supply chain this would not give the company the competitive advantage and can hinder the sustainability and would result in the less or lack of chain communication which can bring more supply chain flexibility.

Supplier-Buyer Relationship and supply chain performance

The willingness of the all partners is the primary factor in the complex supply chain network to work toward the supply chain traceability implementation. The common goal of meeting the end customer demand more efficiently and adhering to higher safety and quality of the product can influence the supply chain traceability implementation.

As each stage in the supply chain incur the loss of waste especially where the system is not vertically integrated this can incur higher cost. The traceability implementation can affect the better management of cost by reducing waste, by help to reduce the recall cost. The safety standards can help to take the preventive step of stopping the product before reaching the end customer can reduce the legal cost which may affect the company brand value by reducing the share value which can be part of cost.

The cost being the primary factor in relation to implementation and sustainability of the common system the cost sharing would help to reduce the burden for each player by intern making the supply chain more competitive.

The supplier buyer relationship in the supply chain network is primarily driven by the strong player. The influence of the strong player to push the supply chain to comply with the common method of tracking and tracing the product would result in more efficient supply chain traceability. For example in the Walmart supply chain the Walmart pushing their supplier to use RFID tags to track and trace the product would help to reduce the cost of inventory management at each stage and reducing the waste and increasing the cash flow.

6. Conclusion

The current study of relationship of level of traceability and the resources required to achieve the level of

traceability and supplier-buyer relationship on the supply chain performance from the distributor prospective in the supply chain network for the dairy product in an unintegrated supply chain. This study shows there are few critical traceability point like once the pallets are received in the distribution center and moved to the retailer the batch details not associated with the moving product in the system. The lack of continuous monitoring of product temperature can result in the product quality detrition which would not be identifiable once the product is again stored back to the required temperature. The absence of supplier buyer strong collaboration and information sharing would result in limited information movement across the supply chain. These would influence on the supply chain performance by increasing the waste at each stage in the supply chain due to the product perishability nature. The absence of batch number tracing can increase the recall cost and the risk associated with absence of timely recall. Hence the high level of traceability implementation by effective cost sharing across the supply chain can give all the sectors the competitive advantage and would help to manage their inventory better. This can help to increase the supply chain flexibility and communication which be achieved by higher level of traceability and effective supplier-buyer collaboration.

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